BULLETIN

OF THE INSTITUTE OF METALS

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INSTITUTE NEWS

" Some Recent Studies of Irradiation Effects in Metals and Other Solids "

A lecture entitled " Some Recent Studies of Irradiation Effects in Metals and Other Solids " will be given by Professor R. Smoluchowski on Wednesday, 13 June 1956. The lecture, which has been arranged by the Metal Physics Committee, will take place in the hall of the Institution of Naval Architects, 10 Upper Belgrave Street, London, S.W.1, beginning at 6.30 p.m.

Professor Smoluchowski is Professor of Physics and Metallurgical Engineering at the Carnegie Institute of Technology, Pittsburgh, Pa.; at present he is Visiting Professor of Physics at the Sorbonne, Paris.

Symposium on " Vacancies and Other Point Defects in Metals and Alloys "

A one-day symposium is being planned by the Metal Physics Committee for the autumn of 1957. Its title will be " Vacancies and Other Point Defects in Metals and Alloys ". About half a dozen review papers are being invited, and these will be available in preprint form before the meeting. Further details will be announced in due course.

Editorship of " Metallurgical Abstracts "

Mr. J. S. Bristow, B.Sc., F.I.M., has been appointed Editor of *Metallurgical Abstracts* and has already taken up his duties.

The Council's decision to make this appointment is an indication of the importance attached to the abstract service provided by the Institute. By having an Editor who can devote his whole time to the work, it is hoped to extend substantially the coverage of *Metallurgical Abstracts*, and to ensure prompter publication of abstracts.

After being educated at Gresham's School and Loughborough College, Mr. Bristow began his technical career in 1937 at the Brown-Firth Research Laboratories, Sheffield, where he later became Personal Assistant to the late Dr. W. H. Hatfield. Subsequently he was for three years Information Officer at the B.S.A. Group Research Centre. During the last two years he has been responsible for organizing and administering a new department of Edgar Allen and Co., Ltd., Sheffield, for the production of tungsten carbide hard metals. He has also worked with metallurgical concerns in France and Germany.

" The Running and Gating of Sand Castings : A Review of the Literature "

The Institute has now published " The Running and Gating of Sand Castings : A Review of the Literature", No. 19 in the Monograph and Report Series. It is by Mr. R. W. Ruddle, M.A., F.I.M., Head of the Melting and Casting Section of the British Non-Ferrous Metals Research Association, whose earlier review, " The Solidification of Castings ", proved very successful.

Considerable research work has been carried out in recent years with the object of placing the design of gating systems on a scientific basis. The results of these researches are reviewed and assessed in the monograph, which also gives details of methods by which the rate of flow of metal in gating systems may be computed from their geometry. The book will be valuable to both the research worker and the practical foundryman.

The monograph, of 183 pages with 65 illustrations, is available from the Institute or through booksellers, price 25*s.* ($3.75), post free. Members may obtain one copy at the special rate of 12*s.* 6*d.* ($2.20), post free.

Annotated Equilibrium Diagram of the Antimony–Tin System

A further addition has just been made to the Institute's Annotated Equilibrium Diagram Series. It is No. 23 : The Antimony–Tin System, which has been prepared by Dr. E. C. Ellwood of the Tin Research Institute.

The diagram may be obtained at the following prices (post free) :

Members (one copy only) . . .	1*s.* 0*d.* ($0.40)
Non-members	2*s.* 0*d.* ($0.50)
Libraries	1*s.* 8*d.* ($0.40)

Accounts for Financial Year 1954–55 : Correction

In the Income and Expenditure Accounts for the year ended 30 June 1955, published in the March issue of the *Journal*, under the heading " Industrial Donations Fund " (p. 285), the item Excess of Income over Expenditure for the Year should read nil instead of £179.

Distribution of the Monthly " Journal " Throughout the World

Members may be interested in the table given on p. 78, which details the distribution of the Institute's monthly periodical throughout the world. Many will be surprised to learn that nearly one-half of the copies printed are despatched to subscribers outside the United Kingdom.

Because of its wide distribution to industrial companies all over the world, the circulation of the Institute's *Journal*, by numbers and quality, is probably unrivalled from the point of view of those advertising their products to the non-ferrous and related industries.

	Members	Non-Member Subscribers	Total
Aden	—	1	1
Argentina	16	6	22
Australia	141	40	181
Austria	5	2	7
Bahrein	3	—	3
Belgian Congo	1	—	1
Belgium	48	14	62
Brazil	6	5	11
Bulgaria	—	1	1
Burma	2	1	3
Canada	104	24	128
Ceylon	1	—	1
Chile	3	1	4
China	3	51	54
Czechoslovakia	4	26	30
Denmark	7	1	8
Egypt	9	3	12
Finland	9	6	15
France	90	53	143
Germany (West)	63	58	121
,, (East)	2	—	2
Gold Coast Colony	1	—	1
Greece	2	—	2
Hong Kong	3	—	3
Hungary	—	11	11
Iceland	1	—	1
India	74	30	104
Iran	2	1	3
Iraq	3	—	3
Israel	3	3	6
Italy	37	23	60
Japan	22	163	185
Kenya	3	—	3
Korea	1	—	1
Kuwait	1	—	1
Malaya	4	—	4
Malta	1	—	1
Mexico	3	—	3
Netherlands	39	15	54
New Zealand	10	4	14
Carried forward	727	543	1270
Brought forward	727	543	1270
Nigeria	2	—	2
Norway	18	10	28
Pakistan	6	2	8
Peru	2	—	2
Poland	—	54	54
Portugal	2	—	2
Rhodesias	15	3	18
Roumania	—	10	10
Saar	3	—	3
Seychelles	1	—	1
Siam	1	—	1
South Africa	52	7	59
Spain	14	9	23
Sweden	58	14	72
Switzerland	38	4	42
Tanganyika Terr.	1	—	1
Thailand	1	2	3
Turkey	1	1	2
Uganda	1	—	1
Uruguay	3	1	4
U.S.A.	688	247	935
U.S.S.R.	1	157	158
Venezuela	2	—	2
Yugoslavia	—	7	7
Unknown	—	4	4
	1637	1075	2712
United Kingdom & Northern Ireland	2941	136	3077
	4578	1211	5789
Advertisers	—	—	100
Exchanges	—	—	23
			5912
Balance held for casual sales and new subscribers			188
Total printing order per month			6100

Election of Members

The following 3 Overseas Sustaining Members, 11 Ordinary Members, 4 Junior Members, and 8 Student Members were elected on 19 April 1956:

As Overseas Sustaining Members

Kensico Tube Company, Inc., Hubbell's Crossroads, Mount Kisco, N.Y., U.S.A.

N. V. De Koninklijke Nederlandsche Lood- en Zinkpletterijen voorheen A. D. Hamburger, Leidse Kade 30, Utrecht, Netherlands.

N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands.

As Ordinary Members

BENNELL, Arthur, B.Sc., Technical and Development Officer, George Christie, Ltd., Ladywell Wireworks, 197 Broomloan Road, Glasgow S.W.1.

BERWICK, Ian Dennis Gray, B.Sc., A.R.S.M., Ph.D., 32 Onslow Gardens, Sanderstead, Surrey.

VAN EIJNSBERGEN, Jan Frederik Hurbert, Ing., Director, Stichting Doelmatig Verzinken, Jan van Nassaustraat 93, 's-Gravenhage, Netherlands.

GONSER, Bruce W., M.S., S.D., Ch.E., Technical Director, Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio, U.S.A.

HOBBS, Glynn Bambury, B.Sc., Metallurgist, Standard Brass, Iron and Steel Foundries, Box 229, Benoni, Transvaal, South Africa.

JONES, Ronald Elward, Assistant Works Manager, Tyseley Metal Works, Ltd., Tyseley, Birmingham 11.

KLEMA, Orvin Allan, B.S., Chief Metallurgist, The Bristol Brass Corporation, 580 Broad Street, Bristol, Conn., U.S.A.

KRAINER, *Professor* Helmut, Dipl.-Ing., Dr.mont., Direktor der Forschungs- und Materialprüfanstalt, Gebr. Bohler & Co., A.G., Kapfenberg, Austria.

MARKSON, Ivor, B.Sc., A.R.T.C., A.I.M., Metallurgist, Titanium Metal and Alloys, Ltd., 2 Metal Exchange Buildings, Leadenhall Avenue, London, E.C.3.

MICHIE, George Mackenzie, M.A., A.Inst.P., A.I.M., Nuclear Power Plant Metallurgist, C. A. Parsons and Co., Ltd., Heaton Works, Newcastle-upon-Tyne.

THELIN, Lewis E., Assistant Chief Metallurgist, The Bristol Brass Corporation, 580 Broad Street, Bristol, Conn., U.S.A.

As Junior Members

PAI, Narasimha Manjunath, B.Sc., Metallurgist, Laboratory, Rylands Brothers, Ltd., Warrington, Lancs.

REEVES, Gordon Leonard, L.I.M., Metallurgist, Tube Investments (Group Services), Ltd., Department of Development and Research, Birmingham.

ROBERTS, John Albert, B.Sc., Ph.D., Scientific Staff, Research Laboratories, The General Electric Co., Ltd., East Lane, North Wembley, Middx.

SHANNON, Lawrence G., Student of Metallurgy, Wandsworth Technical College; Laboratory Assistant, Johnson, Matthey and Co., Ltd., London.

As Student Members

BURLS, Michael Martin, Student of Metallurgy Wandsworth Technical College; Acloque (Metallurgists), Ltd., Lower Morden, Surrey.

HEAD, Edgar John, Student of Metallurgy, Wandsworth Technical College; Laboratory Assistant, British Non-Ferrous Metals Research Association, London.

LINGER, Michael George, Student of Metallurgy, Wandsworth Technical College; Analytical Chemist, Eyre Smelting Co., Ltd., London, S.W.19.

LONG, Leslie Merwyn, Student of Metallurgy, Wandsworth Technical College; Laboratory Assistant, British Non-Ferrous Metals Research Association, London.

MARLOW, Anthony Brian, Student of Metallurgy, Wandsworth Technical College; Assistant Metallurgist, Powers Samas Accounting Machines, Ltd., Croydon.

SIMPSON, John, Student of Metallurgy, Wandsworth Technical College; Research Assistant, Morgan Crucible Co., Ltd., London, S.W.11.

SNEARY, William Warren, Student of Metallurgy, Wandsworth Technical College; Laboratory Assistant, British Non-Ferrous Metals Research Association, London.

WALKER, Joseph Arthur, Student of Metallurgy, Wandsworth Technical College; Laboratory Assistant, Fairey Aviation Co., Ltd., Hayes, Middx.

PERSONAL NOTES

DR. N. P. ALLEN, Superintendent of the Metallurgy Division, National Physical Laboratory, has been elected a Fellow of the Royal Society.

MR. J. E. BOWERS has left the Department of Chemical Engineering, Cambridge, and is now an investigator on the staff of the British Non-Ferrous Metals Research Association.

DR. L. A. CARAPELLA has left the Westinghouse Electric Corp. on his appointment as Director of Product Research, Continental Can Co., Inc., Chicago, Ill.

MR. W. CASTLEDINE has been appointed Lecturer in Management Studies at the North Staffordshire Technical College, Stoke-on-Trent.

DR. J. W. CHRISTIAN is spending several months at the Low-Temperature Physics Laboratory of the National Research Council, Ottawa.

MR. W. C. COPPINS has left the Tin Research Institute and is now Laboratory Superintendent of Bureau of Analysed Samples, Ltd., and Ridsdale and Co., Ltd., Middlesbrough.

MR. D. K. COUTTS has been appointed Manager of the Technical Office of The Mond Nickel Co., Ltd., in Bombay in succession to the late Mr. J. McNeil. He was previously Assistant Manager.

PROFESSOR C. W. DANNATT has been elected President of the Institution of Mining and Metallurgy.

MR. R. B. DAVIES has left the Aeronautical Research Laboratories, Melbourne, in order to take an appointment as Research Investigator with the Electrolytic Zinc Company Pty., Ltd., Risdon, Tasmania.

MR. S. FOLDES has left the Beryllium Corp., Reading, Pa., and is now a metallurgist in the Advance Engineering Group, Direct-Current Motor and Generator Department, General Electric Company, Erie, Pa.

DR. H. H. HAUSNER has left Sylvania Electric Products, Inc., and is now General Manager of the Nuclear Engineering Division of Penn-Texas Corp., New York.

MR. J. G. HINES has been awarded the Ph.D. degree of Cambridge University.

MR. B. W. HOWLETT has left the Metallurgy Department at the University of Birmingham and has joined the staff of the A.E.I. Research Laboratory, Aldermaston, Berks.

MR. R. I. LINDSAY has left Joseph Sankey, Ltd., Bilston, and is now a Technical Officer in the Research Department of Imperial Chemical Industries, Ltd., Birmingham.

MR. A. MOORE has been awarded the Ph.D. degree of Birmingham University and has joined the staff of the Atomic Weapons Research Establishment, Aldermaston, as a Scientific Officer.

MR. M. E. DE MORTON has returned to the Defence Standards Laboratories, Melbourne, after three years' leave of absence spent with the British Welding Research Association.

MR. R. W. NICHOLS has left the Armaments Research and Development Establishment to join the Research and Development Branch of the U.K. Atomic Energy Authority (Industrial Group), Culcheth, Lancs.

MR. H. SILMAN has been appointed to the Board of Directors of the Electro-Chemical Engineering Co., Ltd., Weybridge, Surrey, and has relinquished his position as Research Manager at the Ford Motor Co., Ltd., Engineering Research Centre, Birmingham.

MR. R. A. SKINNER has left the Birmingham Battery and Metal Co., Ltd., and has taken up the position of Co-ordinating Metallurgist to the A.E.I.–John Thompson Nuclear Energy Co., Ltd.

MR. J. E. SRAWLEY has left the Arwood Precision Casting Corp. and has been appointed Supervising Metallurgist, Metallurgy Division, Naval Research Laboratory, Washington 25, D.C.

MR. P. N. VERNON has taken up a post as Learner Official at Chibuluma Mines, Ltd., Northern Rhodesia.

LETTERS TO THE EDITOR

"Canning" in Reactor Contexts

I hope it is not too late to suggest to Dr. McIntosh, Dr. Bagley,[1] and others working on nuclear-energy projects that they should abandon the facile use of "can", and hence "canning", in describing "some sort of envelope" to contain uranium fuel. As there is already a vast literature which is properly indexed under "cans" and "canning", nuclear specialists will have only themselves to thank if their particular needles get lost in someone else's haystack of references. Surely, for their context, it should not be too difficult to coin a suitably distinctive word.

W. R. LEWIS
Assistant Director

Tin Research Institute,
Greenford, Middlesex.

REFERENCE

1. A. B. McIntosh and K. Q. Bagley, *J. Inst. Metals*, 1955–56, **84**, (7), 251.

A Method for Growing Single Crystals of Metals

Although more than one efficient method for the preparation of metallic single crystals has been devised by earlier workers, such as Tammann,[1] Bridgman,[2] and Quimby,[3] the need for an efficient and simple apparatus has been keenly felt. The present communication describes a simple and rapid method for growing metallic single crystals, by slow cooling from the melt.

Metals as a rule supercool slightly, and any rapid cooling either in air or by quenching is accompanied by the formation of small crystal grains. Controlled cooling, however, presents the possibility of producing a single crystal, since fewer seeds are formed. Fig. 1 shows a suitable apparatus for this purpose.

A silica or quartz (transparent type) tube of convenient diameter is sealed off at one end, to contain the metal. By giving the sealed end a conical shape, seeding of the contents is facilitated as a result of the temperature difference existing between the tip and the rest of the metal, since the tip is not in close contact with the heating coil. A spiral of Kanthal wire of 20 S.W.G. (the appropriate length being calculated from the manufacturer's literature) is prepared, of such diameter that the silica tube fits tightly into it. It is desirable to separate the wires by about 1 mm. to obtain an uniform and effective heating zone. An ammeter and an auto-regulator are included in the circuit, as shown in Fig. 1; the former registers the current, while the latter controls the current passing through the spiral and thus the temperature of the furnace. Evacuation is carried out through the open end of the tube. The provision of a means for measuring the temperature seems unnecessary as the contents of the transparent tube are clearly visible.

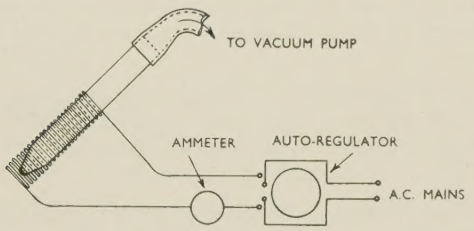

FIG. 1.

The furnace is switched on after the metal has been introduced in appropriate solid form and the evacuation begun. For the safety of the spiral, it is desirable to raise the current very slowly up to a certain limit representing about half the full capacity of the spiral and to maintain that current for about 5 min. Then the current is gradually raised again until the metal inside the tube is seen to start melting. The current is raised a little further, so that the metal reaches a temperature slightly above its melting point. Thereafter the current is kept steady for 30 min. to maintain the molten metal at constant temperature.

Controlled cooling of the melt is then carried out. The rate of cooling must be lower than that of crystallization, as otherwise a number of seeds form, leading to more than one crystal. A constant rate of lowering the temperature of the furnace and a constant (low) limit of fall of temperature has to be maintained. This is effected by the careful adjustment of the total current strength by means of the auto-regulator, the current being observed on the ammeter. For example, silver starts to melt in the author's apparatus when the current is 13·5 amp.; so the current is raised to 14 amp. After this current has been maintained for 30 min., it is reduced to 13·5 amp. and kept constant for 5 min. This procedure is followed until the molten metal reaches a sufficiently low temperature for a solid silver crystal to appear. It is desirable to continue this procedure till the melt attains room temperature. Finally, the crystal is taken out by breaking the tube; the whole mass appears to be one single crystal.

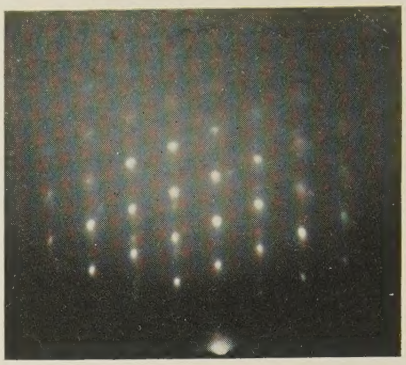

FIG. 2.

Fig. 2 represents an electron-diffraction pattern from the (111) face of a silver single crystal (2·4 cm. in length and 0·9 cm. in dia.), after electropolishing, as suggested by Shuttleworth, King, and Chalmers.[4] The spots in the pattern and the absence of rings indicate a single crystal.

D. N. KUMAR

Biophysics Division,
Institute of Nuclear Physics,
Calcutta.

REFERENCES

1. G. Tammann, "Metallography", p. 26. **1925**: New York (Chemical Catalog Co.).
2. P. W. Bridgman, *Proc. Amer. Acad. Arts Sci.*, 1925, **60**, 303.
3. S. L. Quimby, *Phys. Rev.*, 1932, [ii], **39**, 345.
4. R. Shuttleworth, R. King, and B. Chalmers, *Metal Treatment*, 1947, **15**, 161.

NEWS OF LOCAL SECTIONS AND ASSOCIATED SOCIETIES

South Wales Local Section

At a meeting of the Section held at University College, Swansea, on 6 March, Dr. G. E. GARDAM (Aluminium Laboratories, Ltd., Banbury) lectured on:

Processes for the Decoration and Protection of Aluminium

Dr. Gardam said that the increasing use of aluminium for general purposes had increased interest in methods for its decoration and the preservation of its appearance. The natural corrosion-resistance of this very electro-negative metal was due to a self-healing oxide film, and it was natural, therefore to enhance the protection by artificially thickening the oxide film. This could be done by several chemical methods, such as treatment in a boiling sodium carbonate/chromate solution or even by boiling in water, but it was best achieved by anodic treatment in a solution of chromic, oxalic, or sulphuric acid. In this treatment porous films of amorphous oxide could be built up to a thickness of several thousandths of an inch. The rather complicated mechanism, as revealed by recent research, was explained. The porosity of the film could be varied by adjustment of conditions from a glass-hard, compact but brittle mass

to a more open type readily receptive to dyestuffs, which could be subsequently sealed. The protection afforded by a sufficiently thick, well-sealed film was extremely high: on super-purity aluminium or its alloys with magnesium, the film was formed in sulphuric acid and was transparent and invisible.

Aluminium alloys could be readily brightened by electrolytic or purely chemical methods, and some processes had marked smoothing action. Super-purity aluminium could be "bright anodized" to surpass chromium plate in brilliance, durability, and economy, e.g. for car trim. The electroplating of aluminium was difficult owing to the natural oxide film which had either to be replaced by chemical substitution of another metal such as zinc, or to be thickened in a porous manner to provide a foundation for electroplated copper. Plating of the desired metal could follow, but unless it was entirely non-porous, blistering occurred on severe exposure, and electroplating of aluminium was not advised.

JOINT ACTIVITIES

Sixth Commonwealth Mining and Metallurgical Congress

The Sixth Commonwealth Mining and Metallurgical Congress will take place in Canada in September and October 1957, by invitation of the Canadian Institute of Mining and Metallurgy. Meetings will be held in a number of important Canadian cities, and an extensive programme of visits to mines, oil wells, refineries, &c., is being arranged. The Congress opens in Vancouver, B.C., on 8 September and closes in Halifax, N.S., on 9 October.

A preliminary brochure dealing with the Congress is now available and a second brochure is in preparation, giving full details. All communications should be addressed to the Executive Secretary, Sixth Commonwealth Mining and Metallurgical Congress, 507 Metropolitan Building, 837 W. Hastings Street, Vancouver 1, B.C., Canada.

OTHER NEWS

International Conference on Fatigue of Metals

An International Conference on Fatigue of Metals, sponsored by the Institution of Mechanical Engineers in co-operation with the American Society of Mechanical Engineers, will be held in London on 10–14 September and in New York on 28–30 November 1956.

Some 70 papers will be presented by reporters for discussion at a series of sessions dealing with: "Stress Distribution", "Temperature, Frequency, and Environment", "Metallurgical Aspects of Fatigue", "Basic Studies", and "Engineering and Industrial Significance of Fatigue". Visits to centres at which research on fatigue is being carried out are being arranged for 17–21 September.

The opening and closing sessions of the Conference will be held at the Central Hall, Westminster. The remaining sessions will be held in the meeting hall of the Institution of Mechanical Engineers.

The Institute of Metals is one of a number of professional bodies interested in the subject of fatigue of metals which have been invited to participate in the Conference. Members of the Institute may, therefore, take part in the Conference on equal terms with members of the Institution of Mechanical Engineers. Preliminary reply forms can be obtained from the Secretary, The Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

Persons wishing to register to attend one or all of the Technical Sessions will be required to pay a registration fee of one guinea. An additional fee of one guinea will be payable by those wishing to take part in visits. Advance copies of papers will be available in August, price £1 per set (or 3*s*. 6*d*. for the papers presented at any particular session).

"Physics of Some New Aspects of Non-Destructive Testing"

The Summer Meeting of the Non-Destructive Testing Group of the Institute of Physics will be held at the H. H. Wills Physical Laboratory, Bristol, on 11–14 July 1956. The theme of the Meeting will be "Physics of Some New Aspects of Non-Destructive Testing", and the object will be to stimulate an interest in the new techniques and ideas now being introduced into the broadening field of non-destructive inspection, and also to indicate the present limitations in knowledge of the relationships between the physical properties and the mechanical behaviour of materials.

Details may be obtained from the Group Honorary Secretary, R. S. Sharpe, Bristol Aero-Engines, Ltd., Filton House, Bristol.

Second International Congress of Surface Activity

The first International Congress of Surface Activity was held in Paris in 1954. The second Congress will be held in London on 8–12 April 1957, with Lord Brabazon of Tara as the President of Honour and Professor Sir Eric Rideal as the President.

Membership of the Congress is open to all interested persons on payment of the membership fee of £4. It is hoped to issue a detailed programme in the near future and all enquiries should be addressed to: The Honorary Secretary, Second International Congress of Surface Activity, 14 Belgrave Square, London, S.W.1.

APPOINTMENTS VACANT

HIGH DUTY ALLOYS, LTD., RESEARCH DIVISION, SLOUGH, BUCKS, require metallurgists for investigations into the properties, development, and fabrication of titanium-base alloys and also of aluminium-base sintered materials. Candidates should possess an Honours Degree, or its equivalent, and have some experience, preferably in titanium alloy metallurgy. The post offers scope for initiative and enthusiasm in an important and progressive organization. The salary paid will be commensurate with qualifications and experience. Applications, giving full details, should be addressed to: Staff Manager, High Duty Alloys, Ltd., Slough, Bucks.

IMPERIAL CHEMICAL INDUSTRIES, LTD., Billingham Division, requires an experienced METALLURGIST for work in the Division Metallurgical Laboratories. The work is varied and deals with the wide range of metallic materials and fabrication processes used in the erection and maintenance of many chemical processes.

The man appointed will be required to assist in the diagnosis of equipment failures and will be expected to undertake original research work; encouragement is given for publication of papers based on such work.

The Division's metallurgists are in regular contact with Research Associations and other industrial laboratories; they also maintain contact with contractors engaged in work for the Division.

In selected cases, arrangements are made for metallurgists on the Company staff to spend appropriate periods in the Works of a metal-producing or fabricating organization, with a view to acquiring practical experience of such operations.

Candidates should be in the age group of 27–35, should have a good degree in metallurgy, and several years' experience in industry, preferably in a branch of the metal- or equipment-producing industries.

The appointment is permanent and pensionable. An attractive salary is offered, and assistance can be given towards house purchase.

Write, giving brief details of age, qualifications, and experience to the Staff Manager, Imperial Chemical Industries Ltd., Billingham, Co. Durham, quoting reference G.4.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF METALLURGY

Applications are invited from metallurgists or physicists for research in problems of liquid metals, intermetallic compounds, and alloy-transformation phenomena as they are related to behaviour in nuclear reactors. The work will be suitable for submission for the award of higher degrees, but applications from more senior workers will be welcomed. An Honours degree in metallurgy, physics, or a related subject is essential. Salary in the range £400–£900 according to the experience and status of the applicant. Applications to Professor J. G. Ball, Department of Metallurgy, Imperial College, London, S.W.7.

JOSEPH LUCAS (Electrical), LTD., intend to appoint a DEPUTY CHIEF METALLURGIST, with a view to his subsequent promotion to Chief Metallurgist in charge of a staff of about forty. The applicant should, preferably, have an honours degree in metallurgy, and be between the ages of 35 and 45. Experience in the field of light engineering is essential, and in quantity production a distinct advantage. He will be responsible for, and with the aid of specialists be expected to deal with, the specification and testing of incoming materials; production heat-treatment, which includes heating in controlled-atmosphere furnaces and by induction; with carburizing by the solid, liquid, and gaseous methods, and nitriding; with welding, brazing, and soldering; and with pyrometric control. He must have a knowledge of most kinds of cold-forming and machining processes. He will be required to advise metallurgically those who are responsible for engineering design, and to collaborate with those who have to maintain an unusually high level of quantity production. Special notice will be taken of an ability to write clear reports. Apply to the Personnel Manager, Joseph Lucas (Electrical), Ltd., Great King Street, Birmingham 19, quoting reference PM/D/128.

LEAD DEVELOPMENT ASSOCIATION. A vacancy exists for an Assistant to the Technical Manager. Applicants should have a degree in metallurgy, for preference, or chemistry. Salary (minimum £850 p.a.) according to age and experience. Pension scheme. Full details to General Manager, Lead Development Association, Eagle House, Jermyn Street, London, S.W.1.

MECHANICAL ENGINEERING RESEARCH LABORATORY (D.S.I.R.), East Kilbride, offers posts as Senior Scientific Officer or Scientific Officer to metallurgists and physicists interested in research on materials in plastic and elastic ranges: (1) Metallurgists with lively interest in metal physics to collaborate with engineers and physicists in developing metallurgical techniques for studying failure of metals by both fatigue and creep. Officer appointed will take charge of a group providing general services, such as chemical analysis and heat-treatment of wide range of materials (Ref. F.251/6A). (2) Physicist or physical metallurgist to investigate: (i) metallurgical factors involved in formation and cutting of materials, and (ii) development of preferred orientations and plastic strains in metals subjected to deformation. Experience of application of X-ray techniques in industrial research or in above fields an advantage (Ref. F.252/6A). (3) Physicist with experience in X-ray diffraction and a keen interest in metal physics, to assist in researches into fundamental mechanism of the failure of metals by fatigue (Ref. A47/6A). Candidates should normally have a first- or second-class honours degree in an appropriate subject. Exceptionally a candidate without degree may be considered if other training and experience are eminently suitable. Inclusive annual remuneration for a 45½-hour week (men): Senior Scientific Officer £1060–1220; Scientific Officer £503–£911. Rates for women slightly less, but being improved under the Equal Pay Scheme. East Kilbride is a new town with good housing prospects. Application forms from M.L.N.S., Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting appropriate reference. Closing date 24 May 1956.

METALLURGICAL RESEARCH

A Metallurgist or Physicist of some experience is required by THE MOND NICKEL CO., LTD., at their Research Laboratory, BIRMINGHAM, to assist in the development of a wide variety of alloys for high-temperature applications. Good academic qualifications are required, but ability to plan and co-ordinate long- and short-term projects is equally essential. Experience with metallurgical problems arising in internal-combustion-engine practice would be an added advantage. Applications, which will be treated in strict confidence, should be addressed to The Manager, Development and Research Dept., The Mond Nickel Co., Ltd., Thames House, Millbank, London, S.W.1. Mark envelope "Confidential L.26".

METALLURGIST, assistant, required for quality control of works processes. Experience of heat-treatment essential, and knowledge of other processes, e.g. plating, as applied to ferrous and non-ferrous alloys very desirable. Minimum qualification H.N.C., or L.I.M. Write Box No. 407, The Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

METALLURGIST with good qualifications and experience of works practice in the heavy engineering industry, is wanted for a responsible position in a large company with an international reputation. The appointment will necessitate both works control and development work in the field of ferrous metallurgy. Service conditions are likely to appeal to a conscientious man who is prepared to assume responsibility for his judgements and recommendations. The location is in the neighbourhood of Glasgow. Applications, giving full details of training, experience, and salary expectations, will be treated with the utmost confidence and should be addressed to Box No. 408, The Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

NORMALAIR LTD. A graduate in Chemistry or Metallurgy is required for work on a wide variety of problems associated with the manufacture of oxygen breathing apparatus, cabin conditioning valves for operation at elevated temperatures, and cold air turbines under manufacture at the moment and also under development. Previous experience in this work is not necessary. The possibility exists of extending the range of work on to helicopters manufactured by the parent Company at a later date. A generous superannuation scheme exists. Applications giving full details of age, experience, and salary required to the Personnel Officer, Normalair Ltd., Yeovil.

PHYSICAL METALLURGY. An opportunity occurs for an honours graduate, having an interest in research on materials, to join a small team in North Acton investigating projects aimed at developing uses of the platinum metals. The work would be of particular interest to a physical metallurgist or physicist. Salary appropriate to age, qualifications, and experience. Apply to The Manager, Development and Research Department, The Mond Nickel Company, Ltd., Thames House, Millbank, London, S.W.1. Mark envelope "Confidential P.M.3".

PHYSICISTS, METALLURGISTS, AND CHEMISTS required for interesting research and development by Foundry Services, Ltd., for work on a wide range of problems relating to the foundry industry. Good prospects and conditions in an expanding company. A degree, a lively interest in the application of results, the completion of National Service commitments and age within range 22–30 are desirable qualifications. Apply to the Technical Manager, Foundry Services, Ltd., Long Acre, Nechells, Birmingham 7.

UNIVERSITY OF NOTTINGHAM

A SENIOR RESEARCH STUDENTSHIP, value £500 per annum for not more than three years, is offered as from 1 October 1956, for research in one of the following subjects: Civil, Mechanical, Electrical or Mining Engineering or Metallurgy. Candidates must be graduates and must have not less than two years' industrial experience, or a professional qualification.

Further information and forms of application may be obtained from the Registrar, to whom the completed forms must be returned not later than 1 July 1956.